# Climate change impacts on animal health and vector borne diseases

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ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR RESEARCH PROGRAM ON Agriculture for Nutrition and Health
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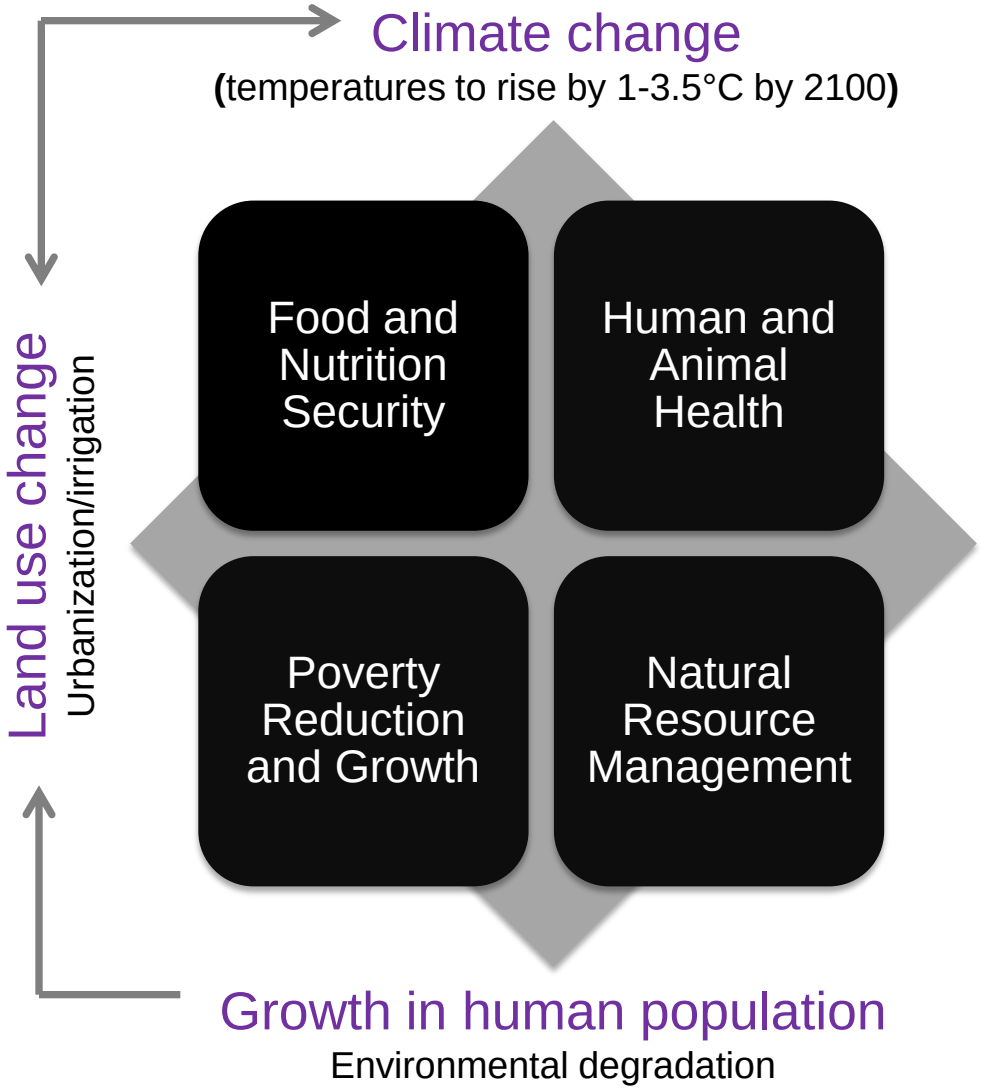
# Outline

1. Global context - livestock domains
2. Climate change and variability
3. Impact of climate change on livestock production
4. Adaptation strategies

# Global contexts – livestock domains




## Feeding the world

**Human population to hit 9 billion by 2050**
**Food production need to Increase by 60%**

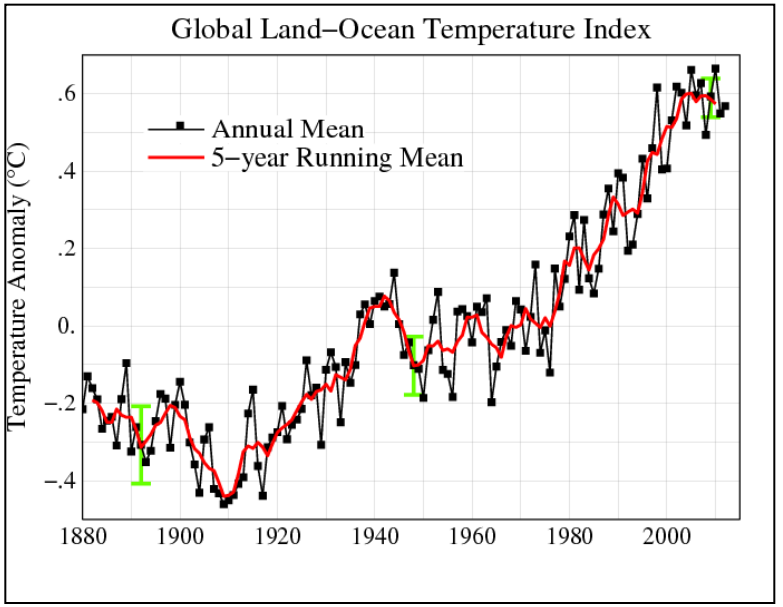
*UN FAO*

*Adapted from Smith J 2011*

# Climate change and variability

- Controversies on whether climate is really changing

- IPCC (2007):
  - last century, temp rose by 1.7°F
  - Expected to rise by 1.0 – 3.5°C by 2100



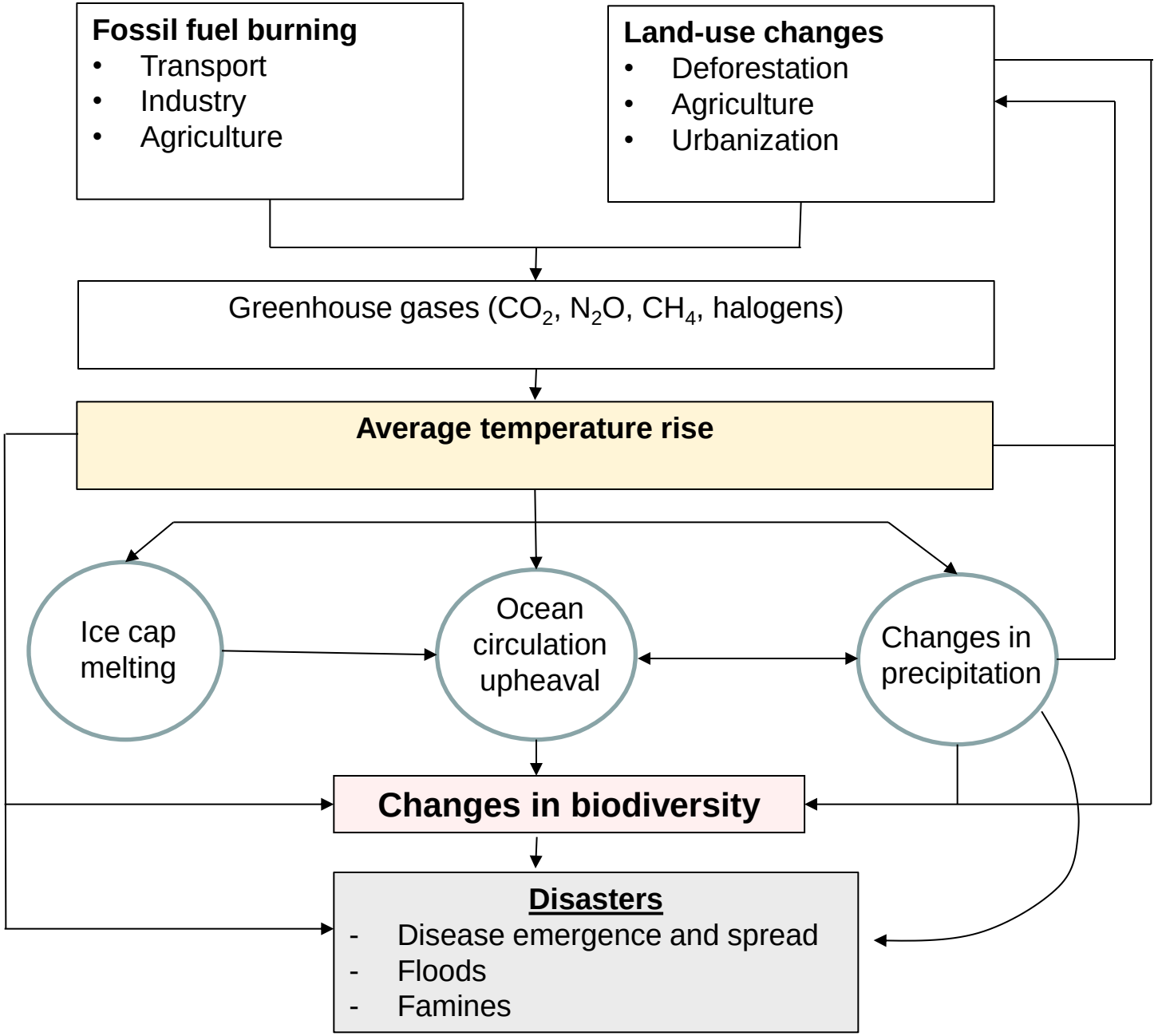

*Source: NASA*

- Precipitation likely to increase in east and decrease in west and north Africa

- Consequences:

  Floods, famines, heat waves, changes in distribution of infectious diseases

# Dynamics driving climate change



# Impact of climate change on livestock production

| | |
|---|---|
| Water<br>- *reduced quantity* | • Change in quantity and timing of precipitation affects<br>- Dry areas will get drier and wet ones wetter |
| Feed<br>- *reduced quality and quantity* | • Land use and systems changes<br>• Decline in productivity of rangelands, crops, forages<br>• Quality of plant material deteriorates<br>• Reduced feed intake<br>Kaptumo, Kenya – climate smart feeding strategies |
| Changes in the incidence of infectious diseases | • Changes in the patterns and range of infectious diseases<br>• Loss of disease resistant breeds<br>• Increased heat stress, deterioration of immunity |

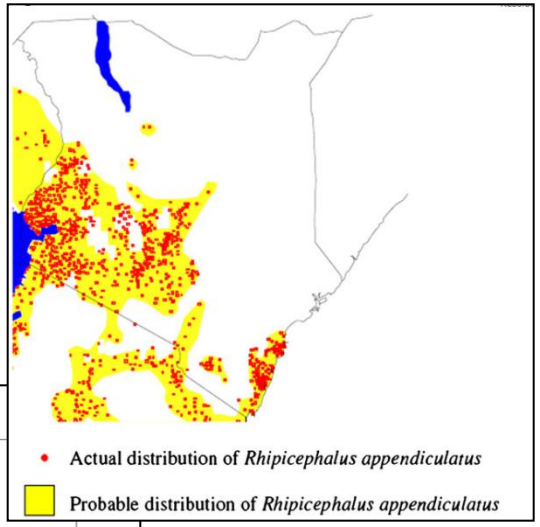
# Climate sensitive-diseases

- Vector borne diseases studied (RVF, tick-borne diseases, tsetse) but other diseases e.g. helminthoses equally important

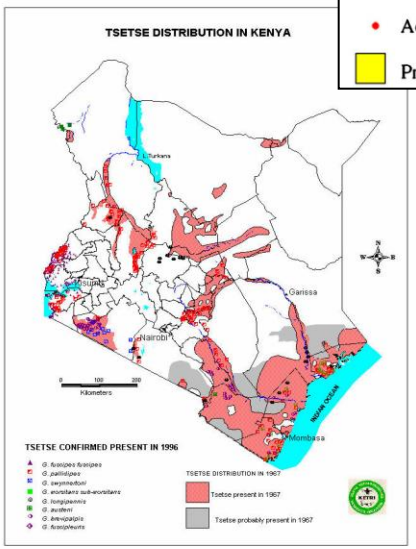
- Mechanisms: short-term, extreme events verses long-term general increases in temperature and precipitation
- Long term effects

- Direct
  - Distribution and development rate of vectors
  - Infection probability and development rates of pathogens in vectors
  - Feeding frequency of the vector
  - Heat stress and hosts' resistance

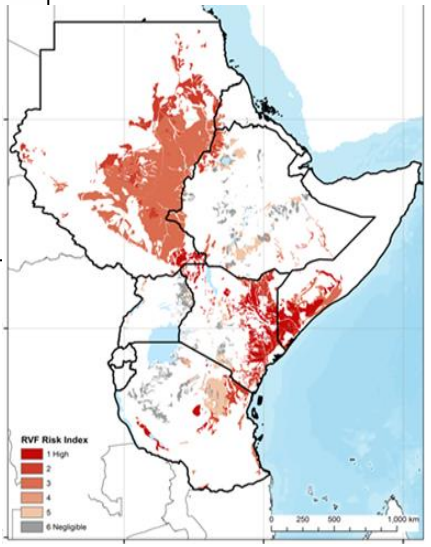
- Indirect:
  - Decline in biodiversity – monocultures of highly productive breeds of animals
  - Land use changes -- irrigation/deforestation




*Rhipicephalus appendiculatus distribution map (***Gachohi et al., 2012**




*Tsetse distribution map (KETRI)*



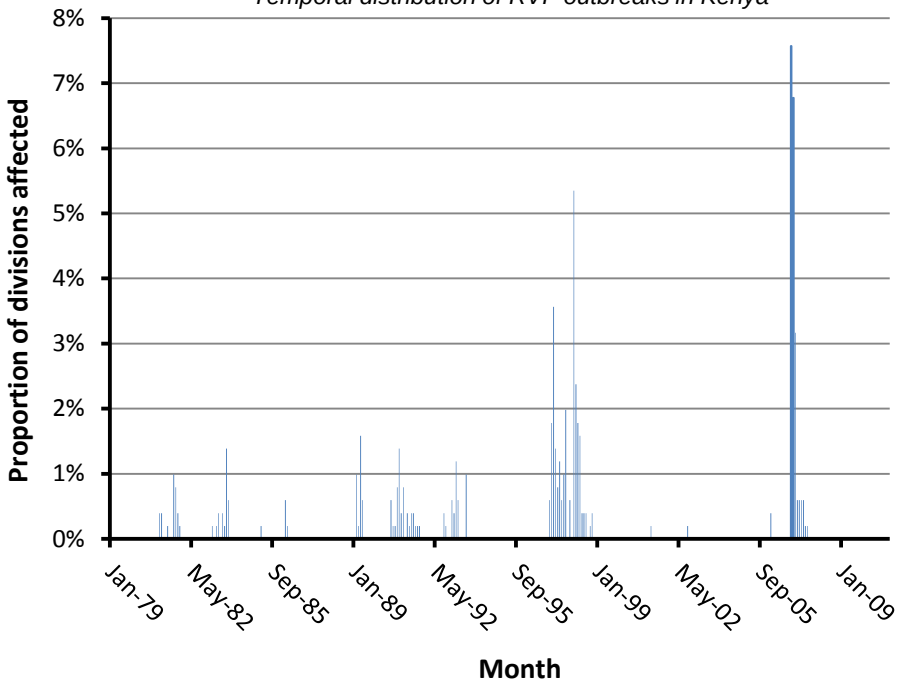

*RVF risk map (ILRI)*

# RVF outbreaks

- Rift Valley fever – mosquito-borne viral disease of sheep, goats, cattle, camels with zoonotic potential
- Outbreaks associated with exceptionally high, persistent rainfall and flooding
- Impacts of 1997-98 and 2006-07 outbreaks:
  - Heavy mortalities, abortions in livestock
  - Disruption of markets
- The last outbreak 2006-2007 caused losses estimated at KES 2.1 billion

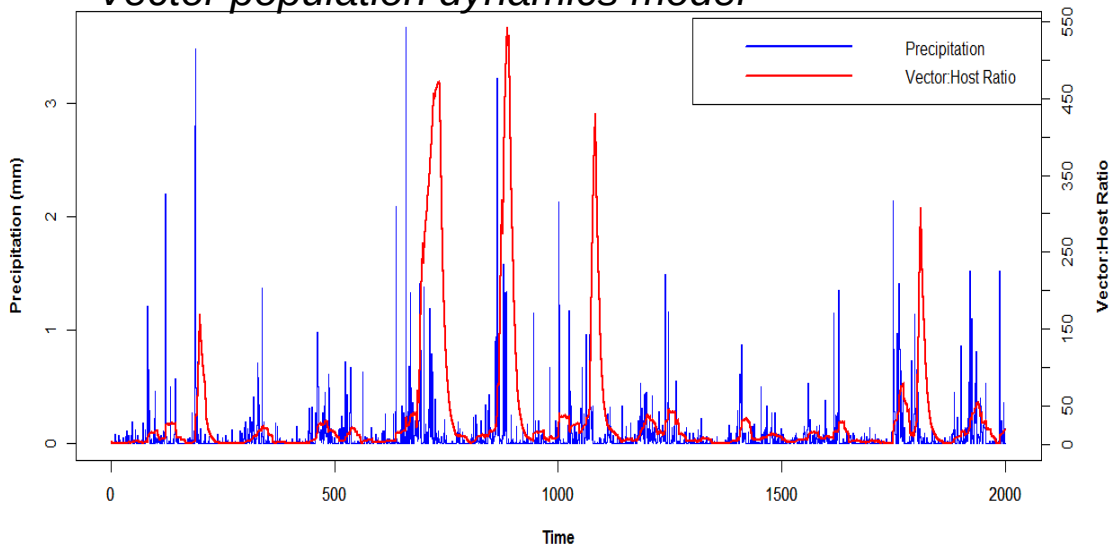
*Floods in Ijara during the recent 2006-2007 outbreak (RVF project, ILRI)*

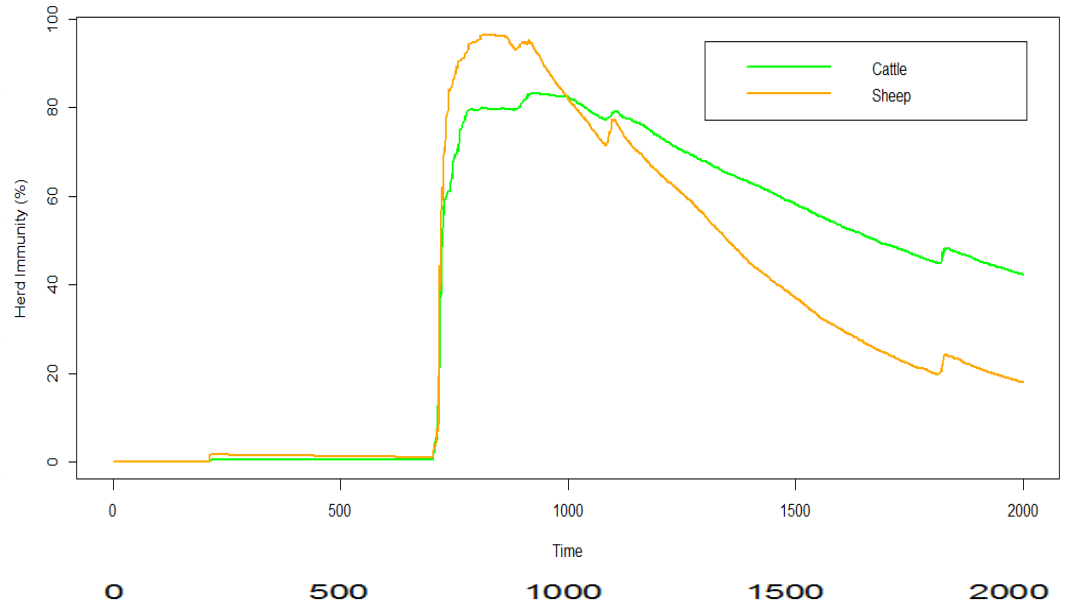
*Temporal distribution of RVF outbreaks in Kenya*



# RVF simulation modelling for decision making

*Vector population dynamics model*



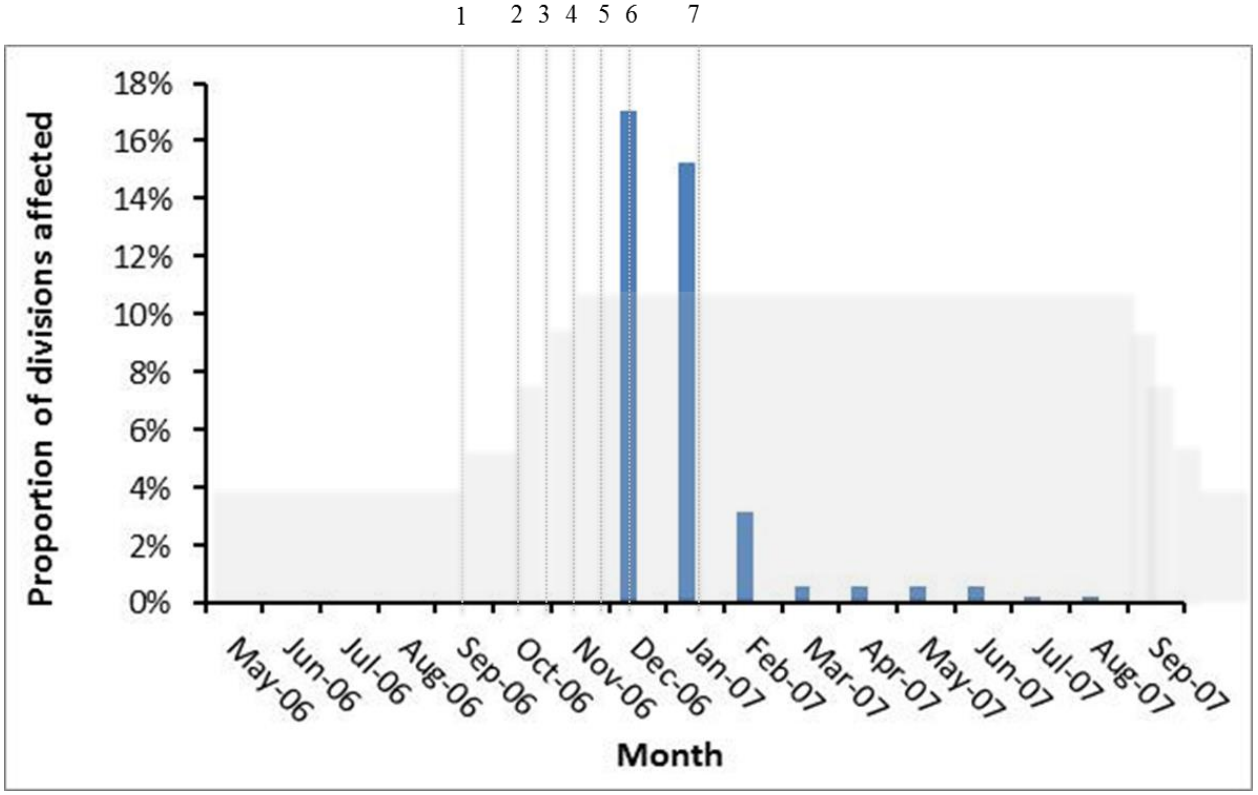

RVF outbreaks follow periods of excessive rains (TRMM precipitation data from NASA)

Interaction between environmental factors, immunity in the disease occurrence and impacts

*Jan 2005*

*July 2010*

# Risk-based decision support framework




1 **First warning of El Nino by NASA/Goddard Space Flight Centre**

2 **Start of heavy rains**

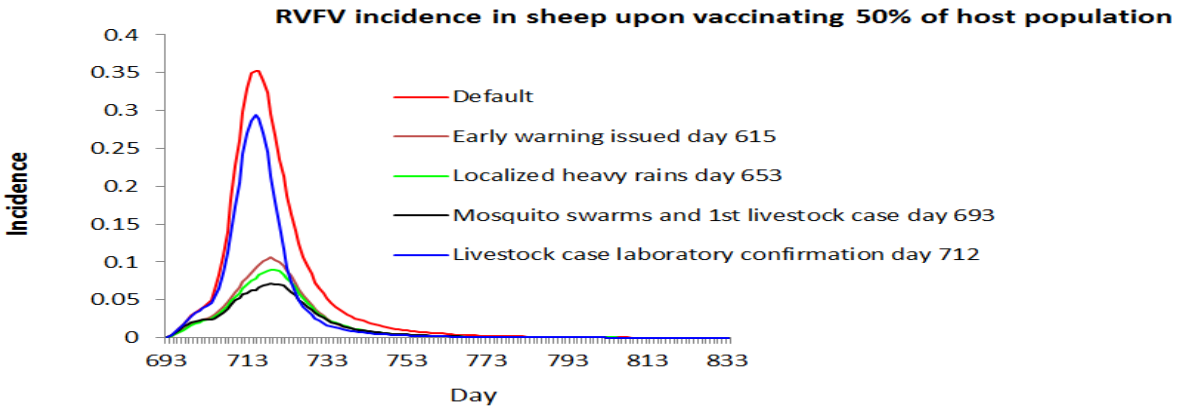
3 **Mosquito swarms**

4 **First case in livestock**

5 **First case in humans**

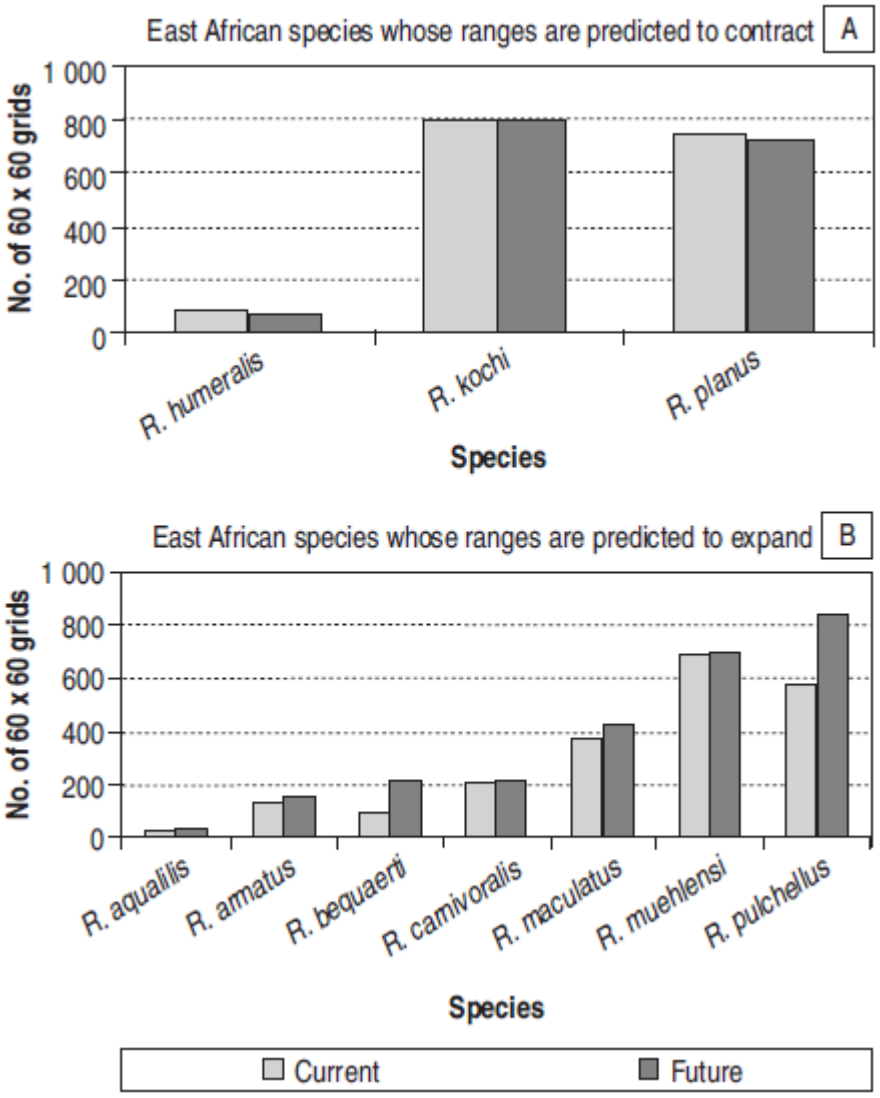
6 **First public health response**

7 **First veterinary service response**



# Other diseases

- Models on ticks (Olwoch et al., 2007 show that the most important ticks are likely to expand in geographical range
- These changes unlikely to be affected by reduction in host diversity since ticks are generalists
- Tsetse – likely to see shifts in distribution though the coverage is expected to shrink due to increase in human population
- Helminthoses – effects of temperature less discernible but improved population dynamics of vectors e.g. snails likely to increase rates of transmission




*Outputs from ecological niche models (Olwuoch et al., 2007)*

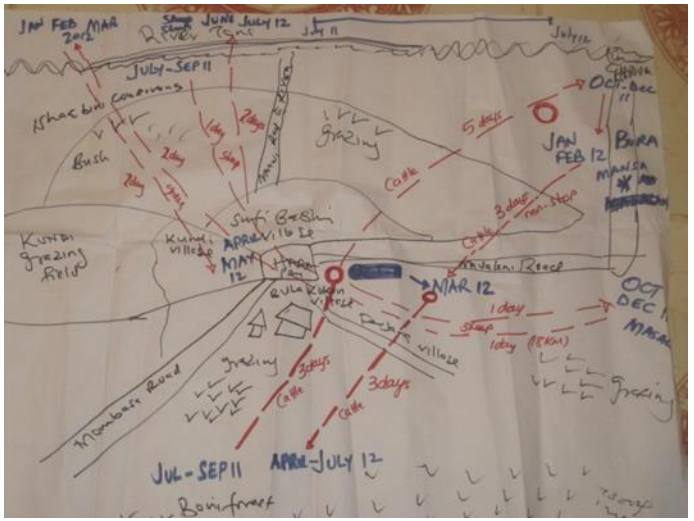
# Challenges on the management of climate sensitive diseases

- Multi-host systems
  - Livestock, wildlife, vectors, sometimes people
- Convergence of diseases in given landscapes
  - Challenges with interventions in areas with multiple disease risks
  - Good for targeting but a challenge for disease management
- Disease prediction:
  - Satellite data being used overestimate rainfall in dry areas and underestimate in the highlands
  - Build capacity on climate issues and other facets of disease transmission

# Other livestock-related challenges associated with climate change

- Challenges associated with climate change/variability
  - More frequent and widespread movements
  - Increase in proportion of small ruminants in herds
  - Conflicts over water and grazing sites

*Participatory mapping to determine ivestock movement patterns*



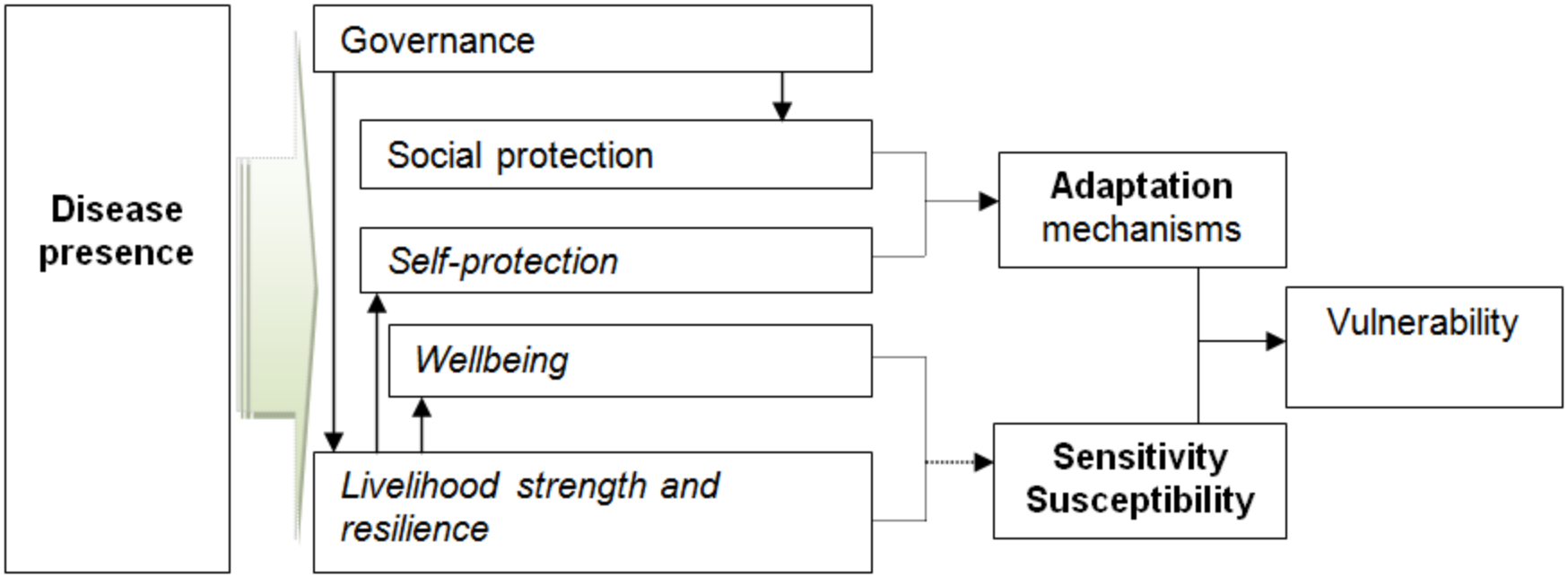

*Proportional piling to determine livestock numbers*


*Access to water -- River Tana*

# Adaptation strategies

- Decision support frameworks
  - Risk maps – for targeted surveillance
  - Prediction models
- Institutional measures
  - Sensitization
  - Climate and Health Working groups
  - Disease control technologies – e.g. vaccines
- Livestock value chain actors – potential interventions:
  - diversify livelihood options
  - Safety nets -- e.g. insurance schemes

# More work? -- Hazard + Vulnerability mapping to determine risk




Conceptual framework adapted from Cannon (2008)

- We will need to combine hazard maps with vulnerability maps for better prioritization of areas/populations for interventions

# Acknowledgements

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